

Delta Flows: Data and Calibrations

Cathy Ruhl

US Geological Survey

California Water Science Center, Sacramento, CA

DSM2 Recalibration

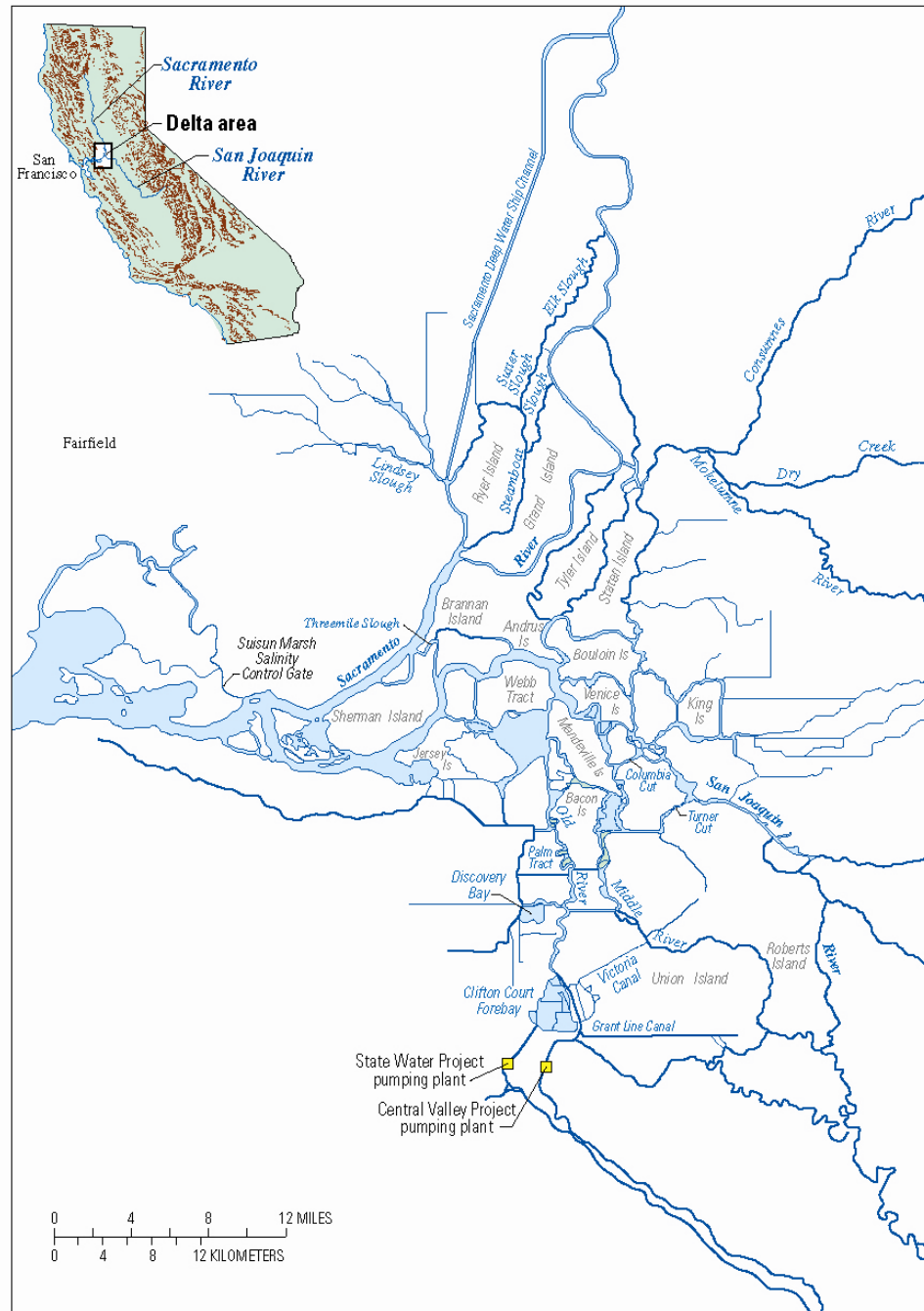
- Metrics for identifying optimal periods
 - Hydrology
 - Density of Data
 - Continuity of Data
 - Confidence in Data

Monitoring Delta Flows

- Project Configuration
- Instrumentation
- Evolution of the Flow Monitoring Network
- Calibration Process / Strengths & Weaknesses
- Data Availability
- DSM2 Recalibration Metrics
- Langinappe
 - Tidal Filters

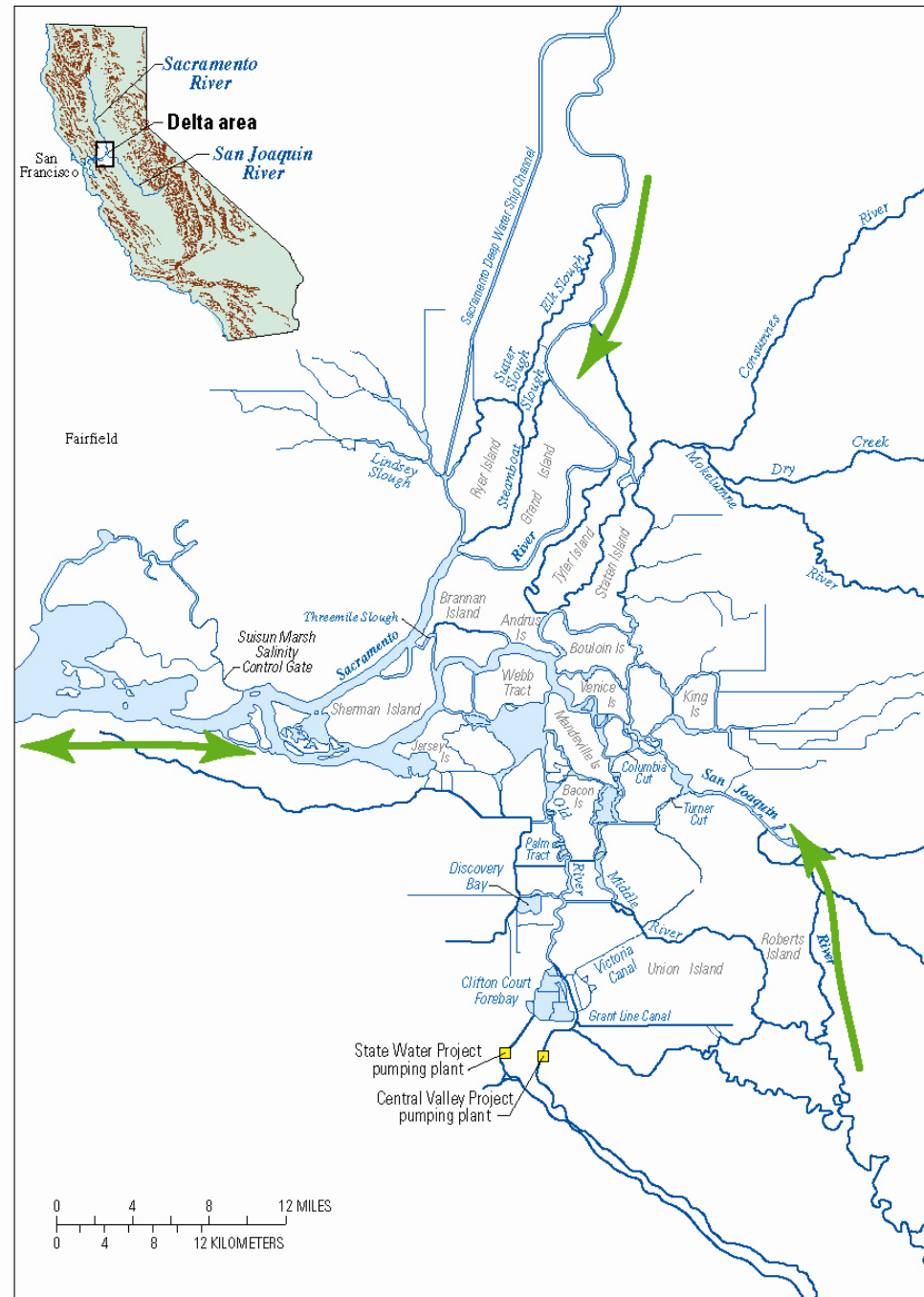
Monitoring – Modeling – Studies





■ Natural

- Upstream hydrology
- Tides
- Atmospheric Conditions

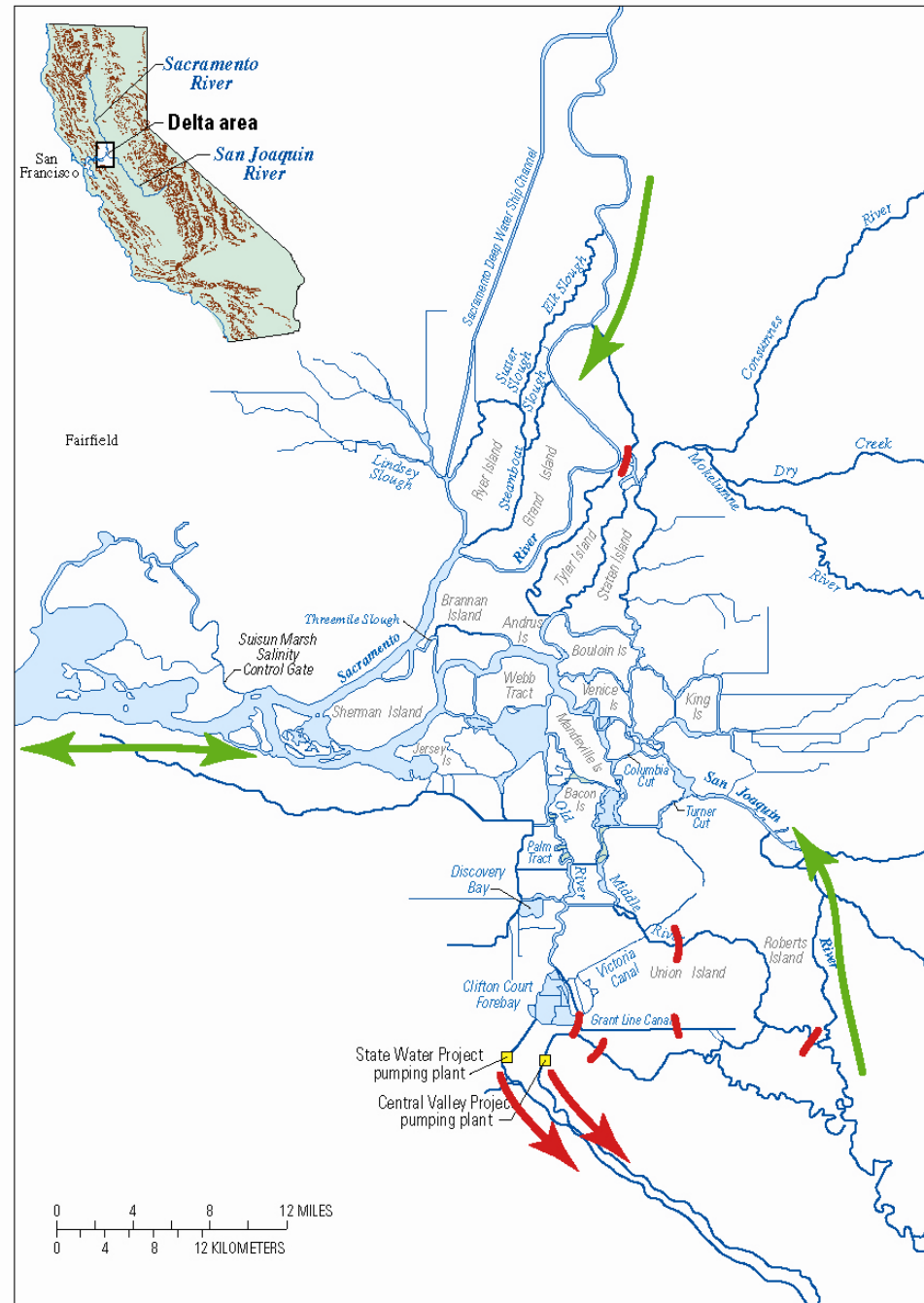


■ Natural

- Upstream hydrology
- Tides
- Atmospheric Conditions

■ Anthropogenic

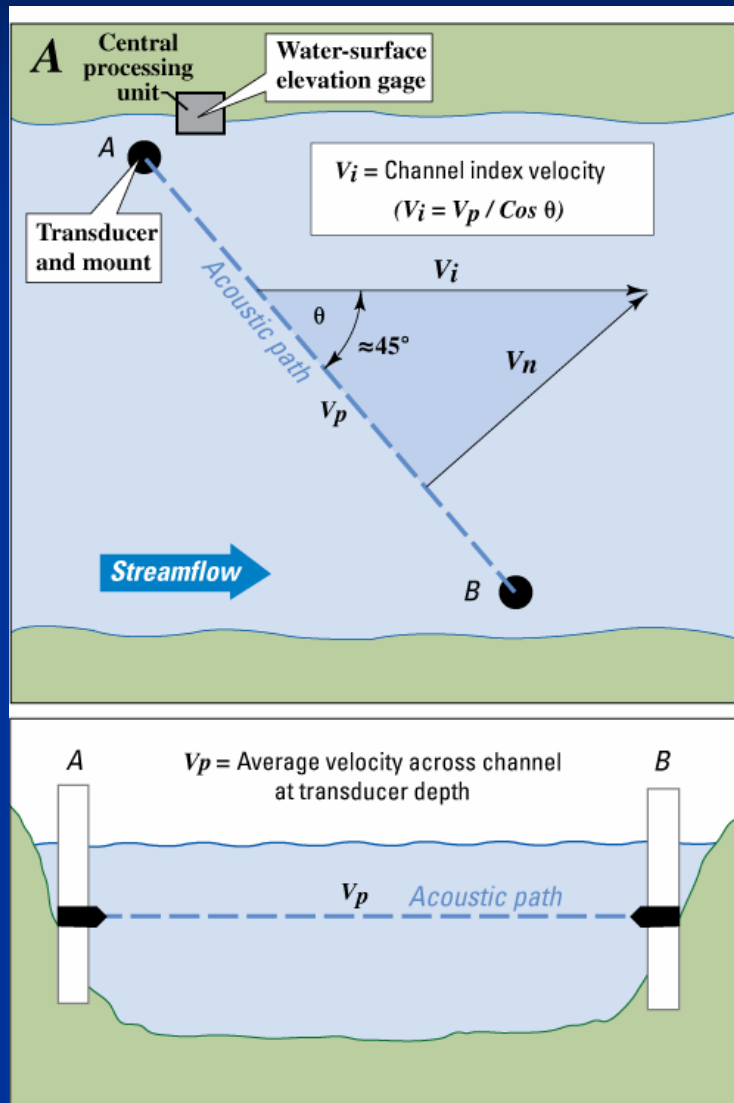
- Export Facilities
- Gates
- Barriers
- Pumps and Siphons
- Dams and Reservoirs



Hydroacoustic Instrumentation

- Ultrasonic Velocity Meters (UVM)
- Acoustic Doppler Velocity Meters (ADV)
 - Horizontal Profiling Capability
 - Sideward-looking (long-term deployment)
 - Upward-looking (short-term deployment)

Hydroacoustic Instrumentation

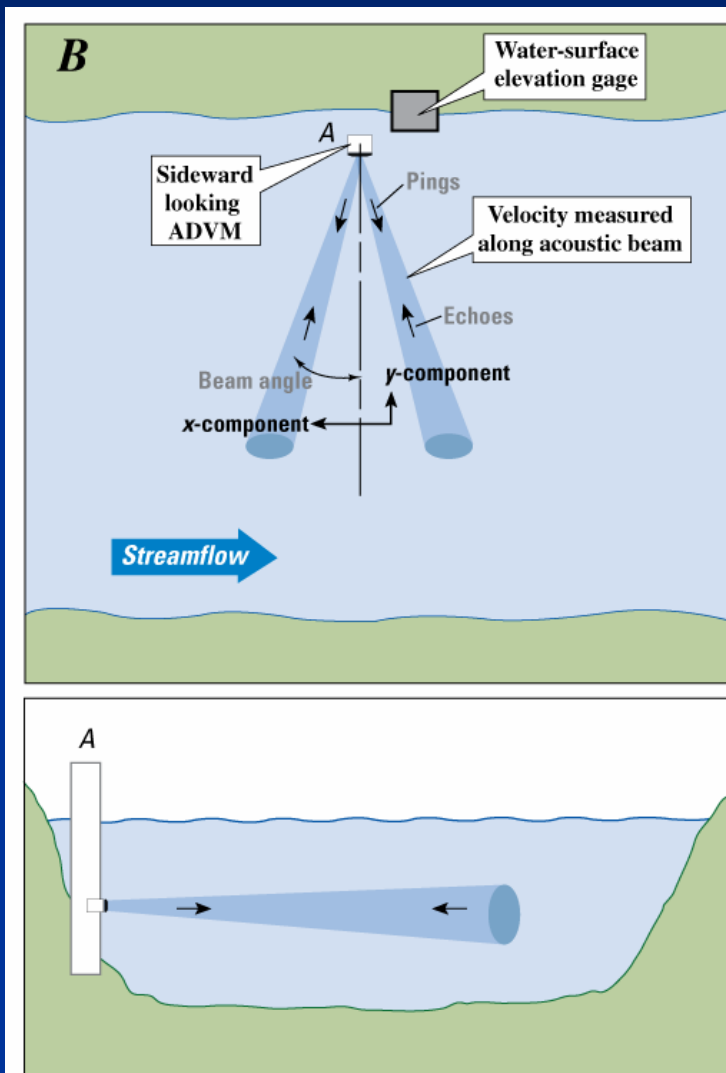


■ Ultrasonic Velocity Meters (UVM)

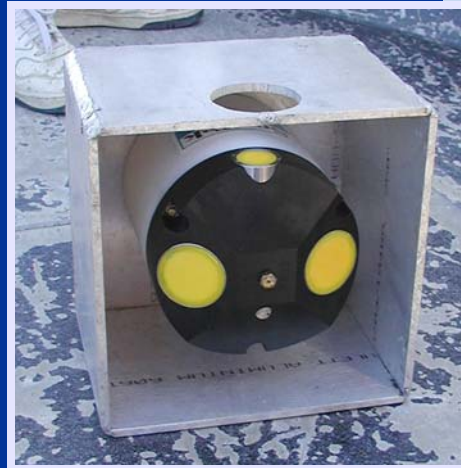
- Innovative application
- Constrained deployment configurations



Hydroacoustic Instrumentation

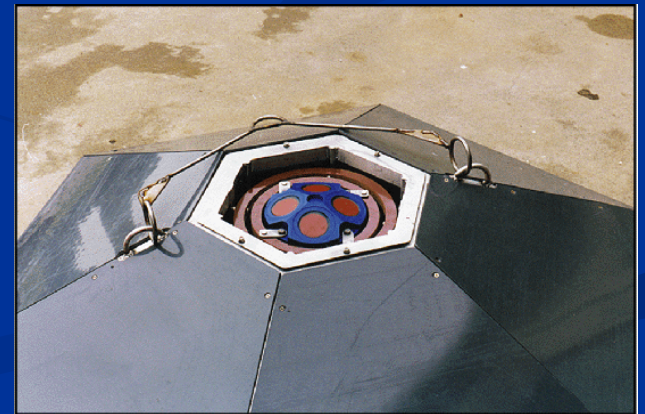
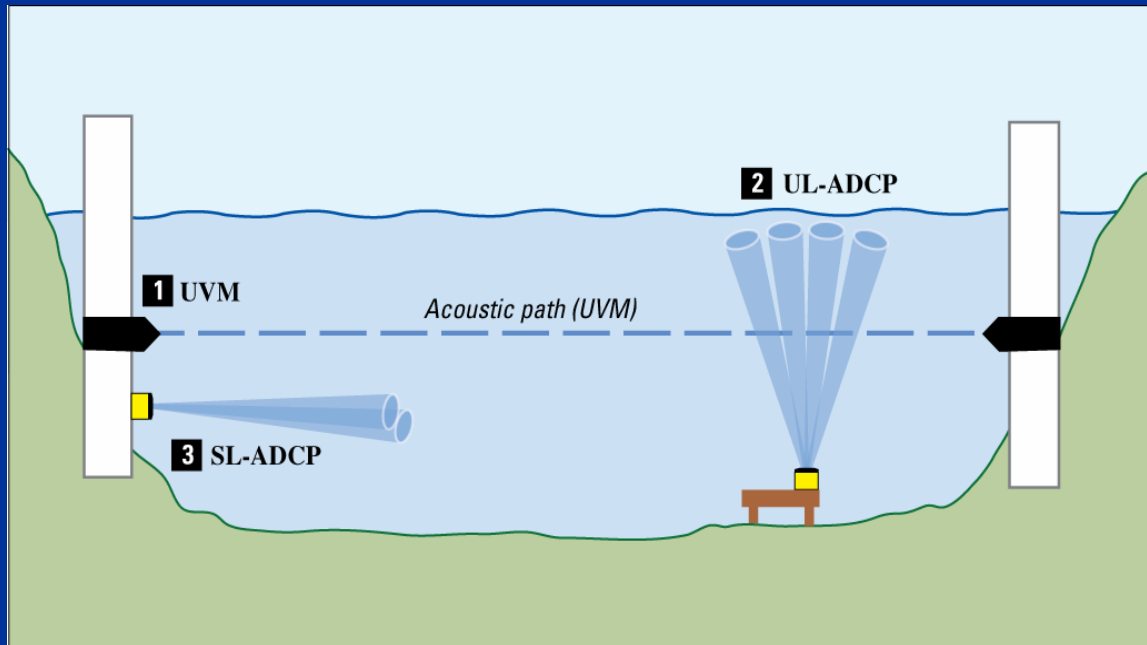


- Acoustic Doppler Velocity Meter
- Flexible Deployment Configuration



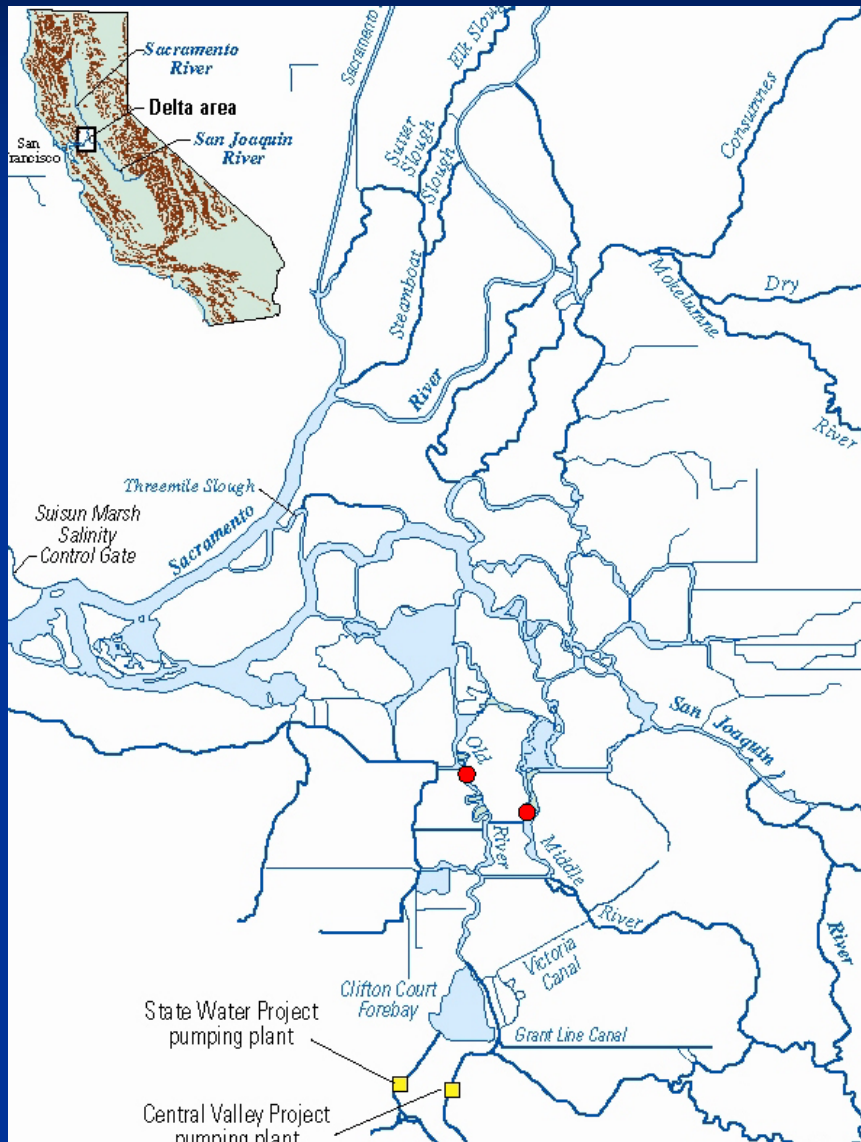
Hydroacoustic Instrumentation

- In-Situ Deployments
 - Flexible locations
 - Short-term only



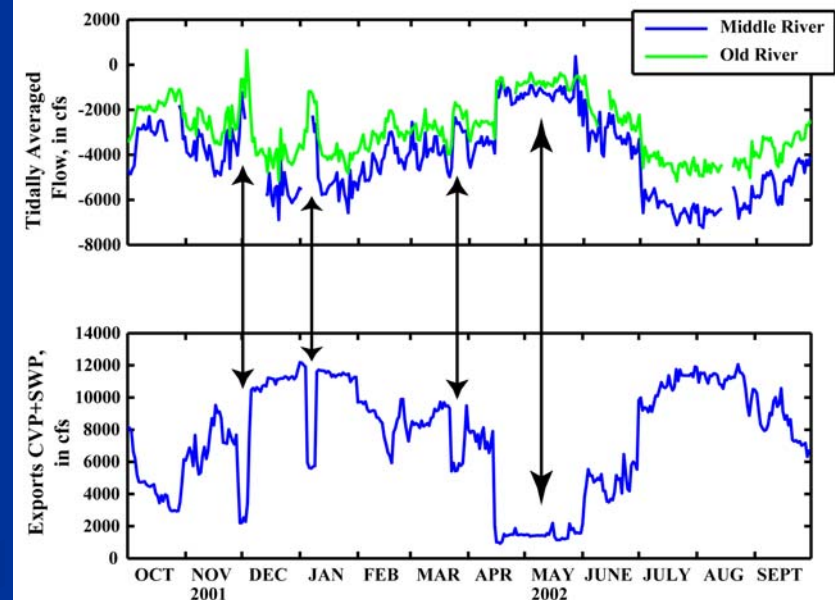
Evolution of the Network

Evolution of the Network

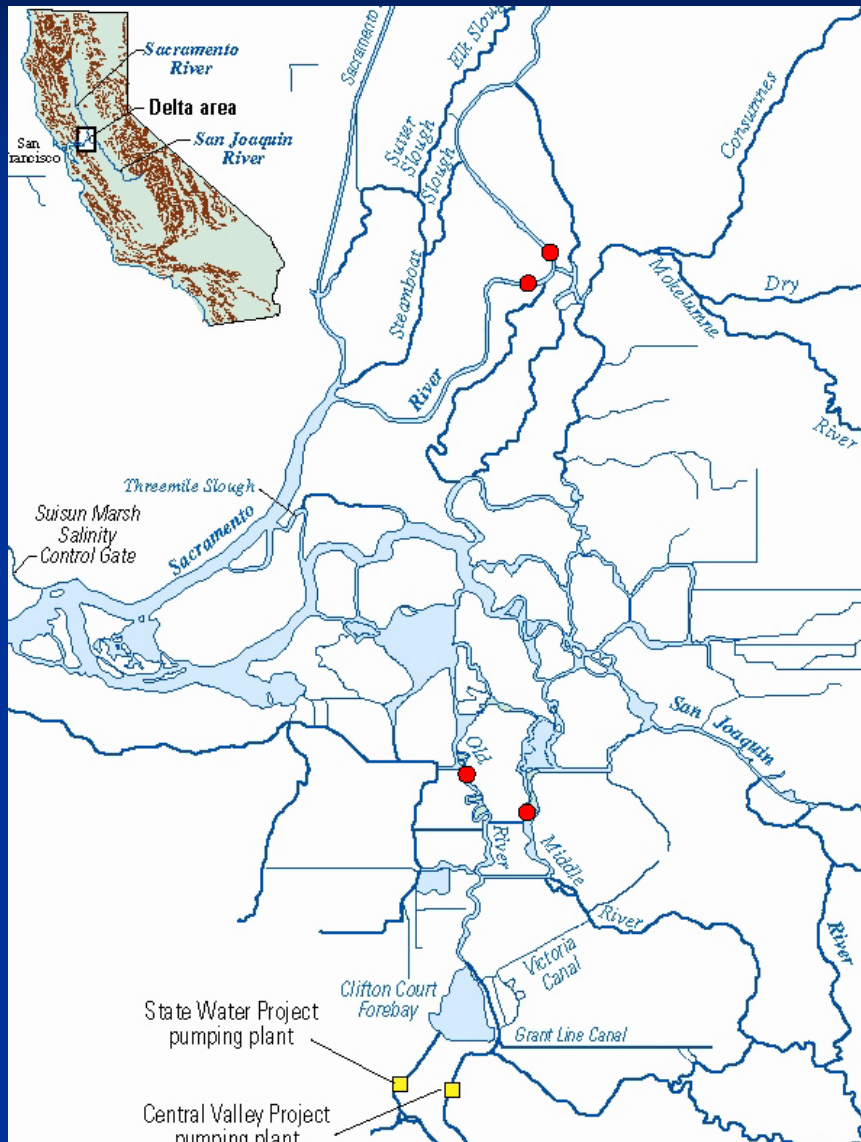


■ 1987: Old River and Middle River

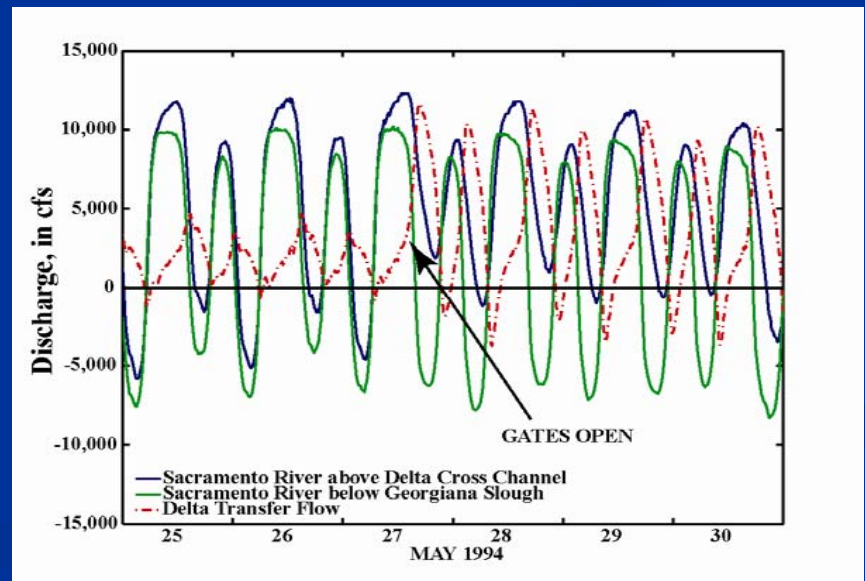
■ Impacts of exports on regional flows



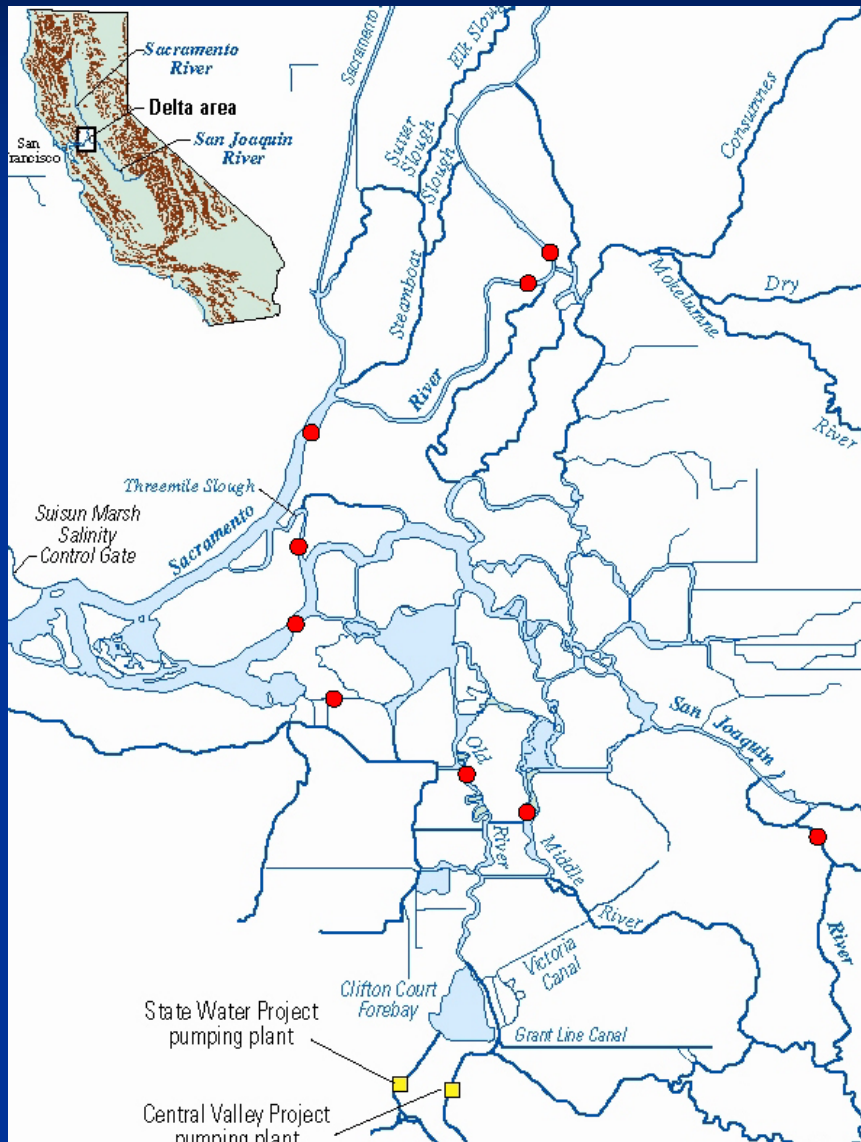
Evolution of the Network



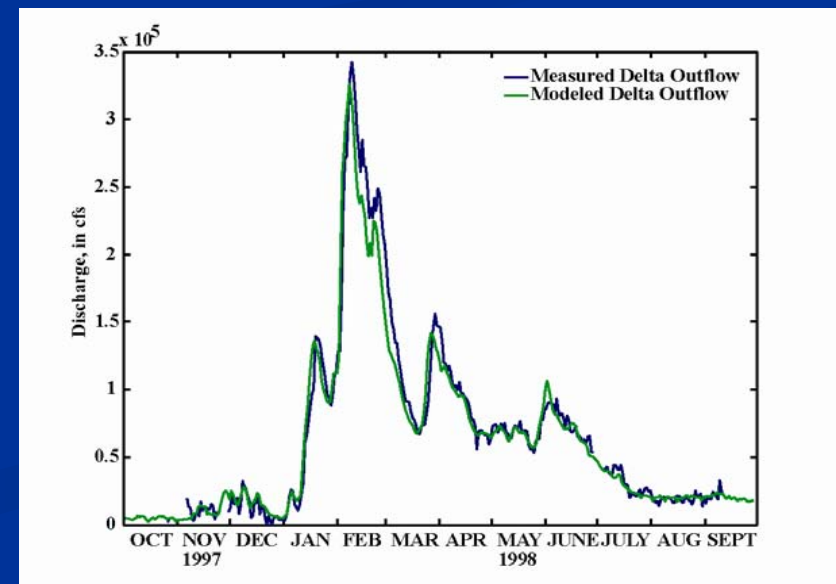
- 1987: Old River and Middle River
- 1992: Walnut Grove
- Delta Transfer Flow



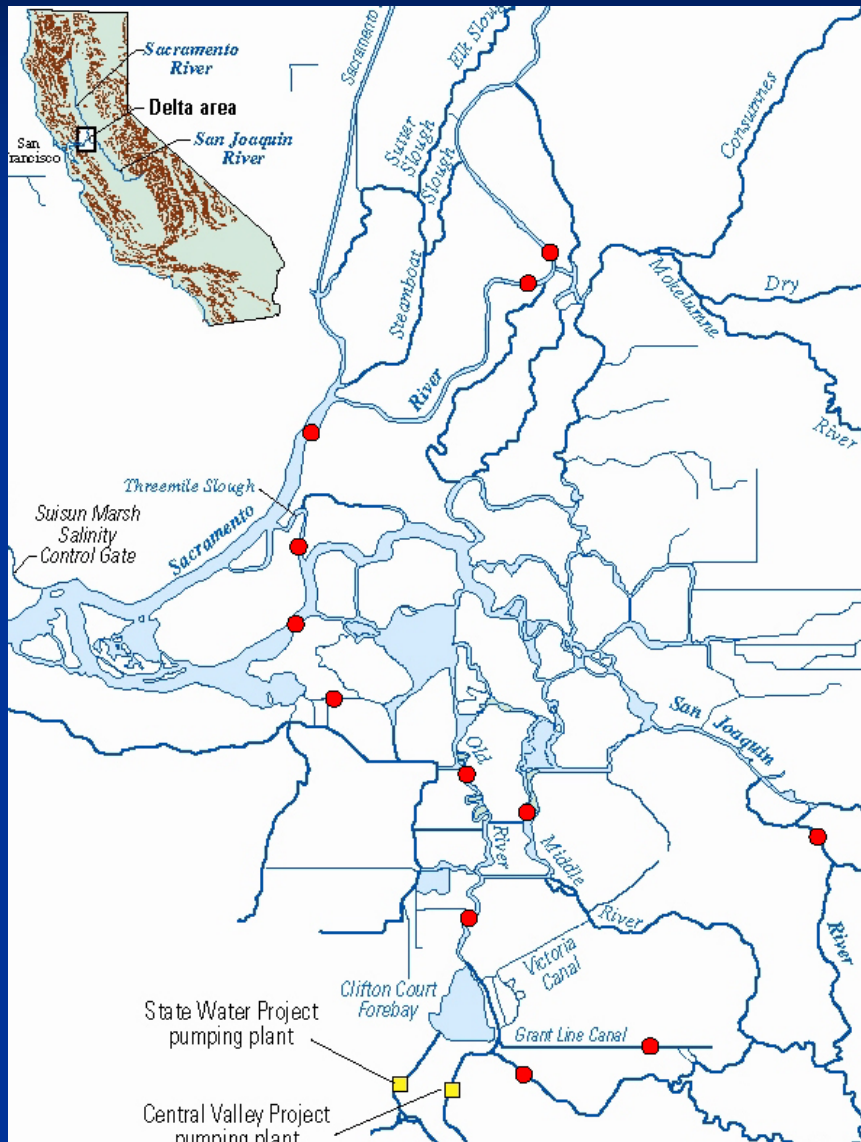
Evolution of the Network



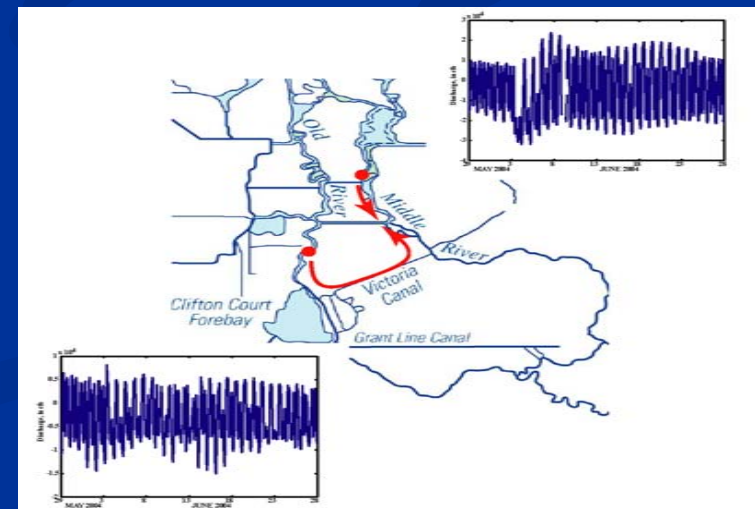
- 1987: Old River and Middle River
- 1992: Walnut Grove
- 1996: Delta Outflow
- Measured vs. Modeled



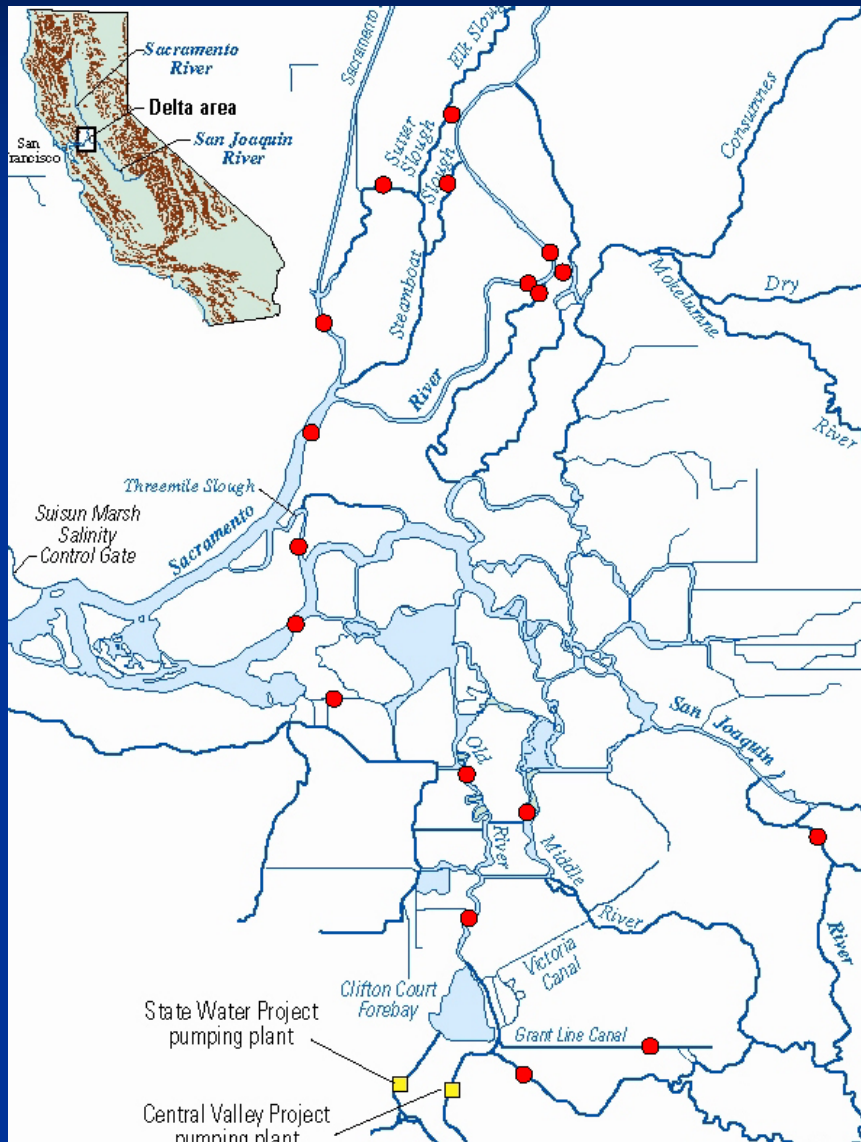
Evolution of the Network



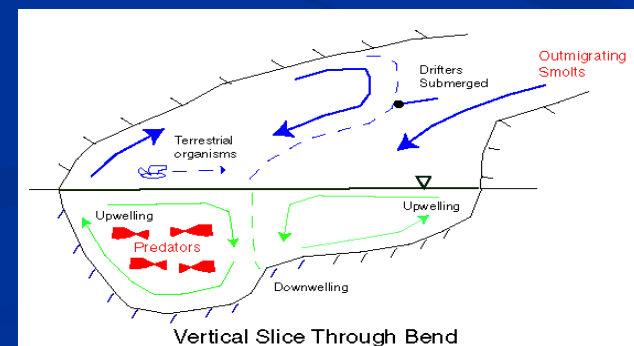
- 1987: Old River and Middle River
- 1992: Walnut Grove
- 1996: Delta Outflow
- 1999: South Delta
 - Jones Tract Breach



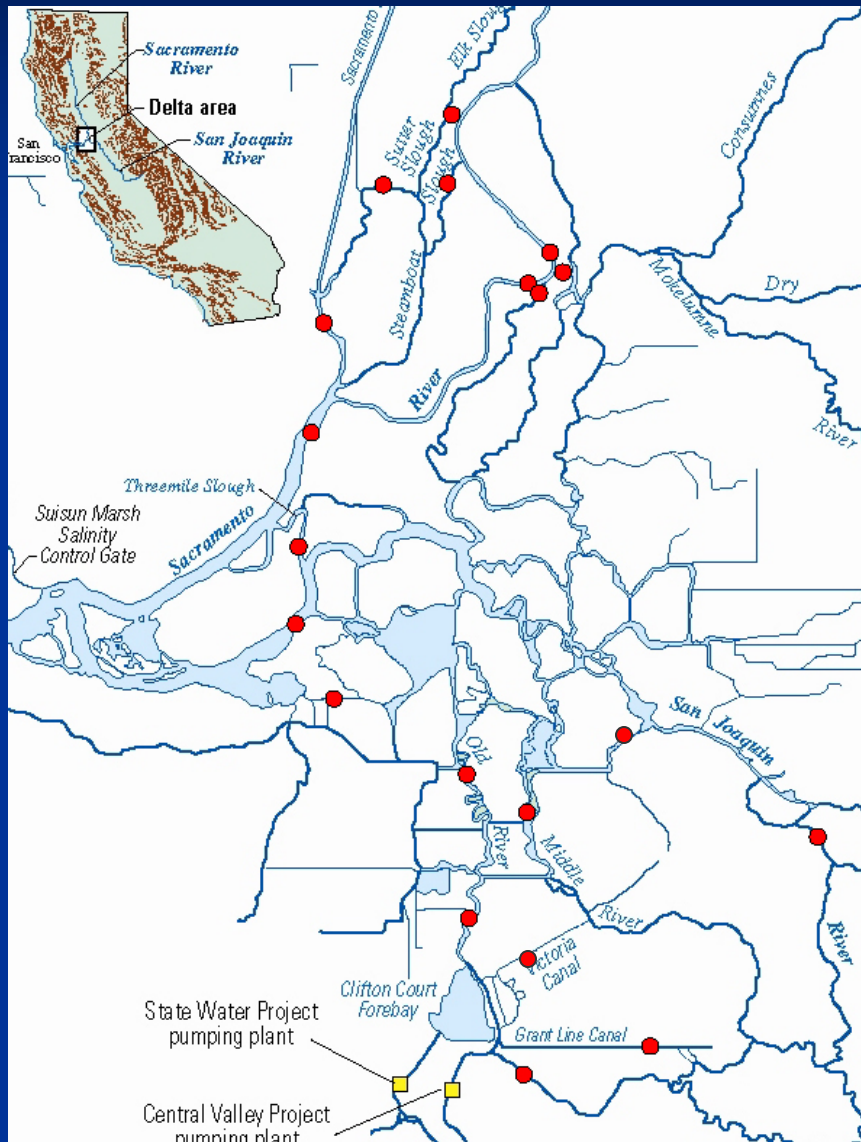
Evolution of the Network



- 1987: Old River and Middle River
- 1992: Walnut Grove
- 1996: Delta Outflow
- 1999: South Delta
- 2001: North Delta
- Salmon Migration Studies

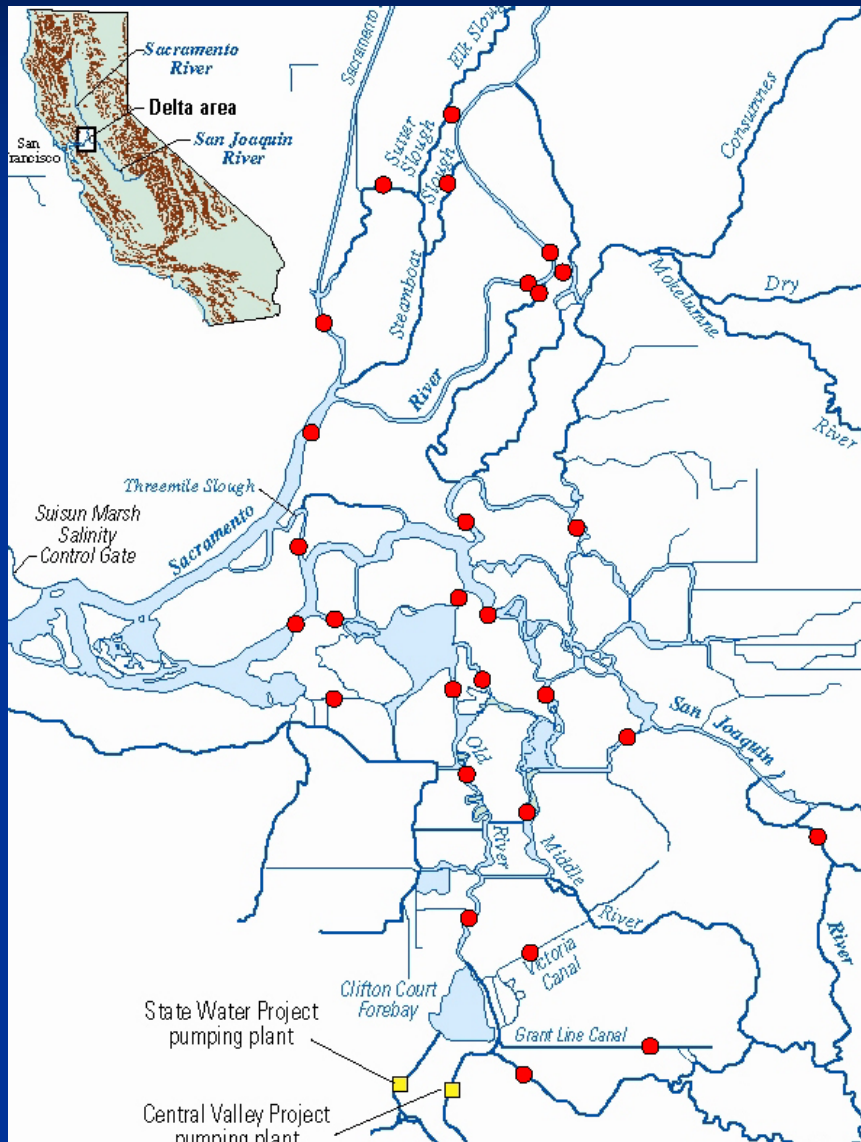


Evolution of the Network



- 1987: Old River and Middle River
- 1992: Walnut Grove
- 1996: Delta Outflow
- 1999: South Delta
- 2001: North Delta
- 2005: South Delta
- Delta Smelt

Evolution of the Network



- 1987: Old River and Middle River
- 1992: Walnut Grove
- 1996: Delta Outflow
- 1999: South Delta
- 2001: North Delta
- 2005: South Delta
- 2006: Central Delta
- Salt flux : DWR Collaboration

Short Term Data Sets

- Early South Delta / Dye Studies
 - Spring / Summer 1997, 1998, 1999
- Confluence Study
 - Fall 1998
- Grizzly Bay
 - Summer to Summer 1999 - 2000
- Delta Cross Channel Studies
 - Fall 2000, 2001, 2002, 2005
- Mildred Island
 - Summer / Fall 2001
- Franks Tract
 - Spring / Summer 2002

Calibration

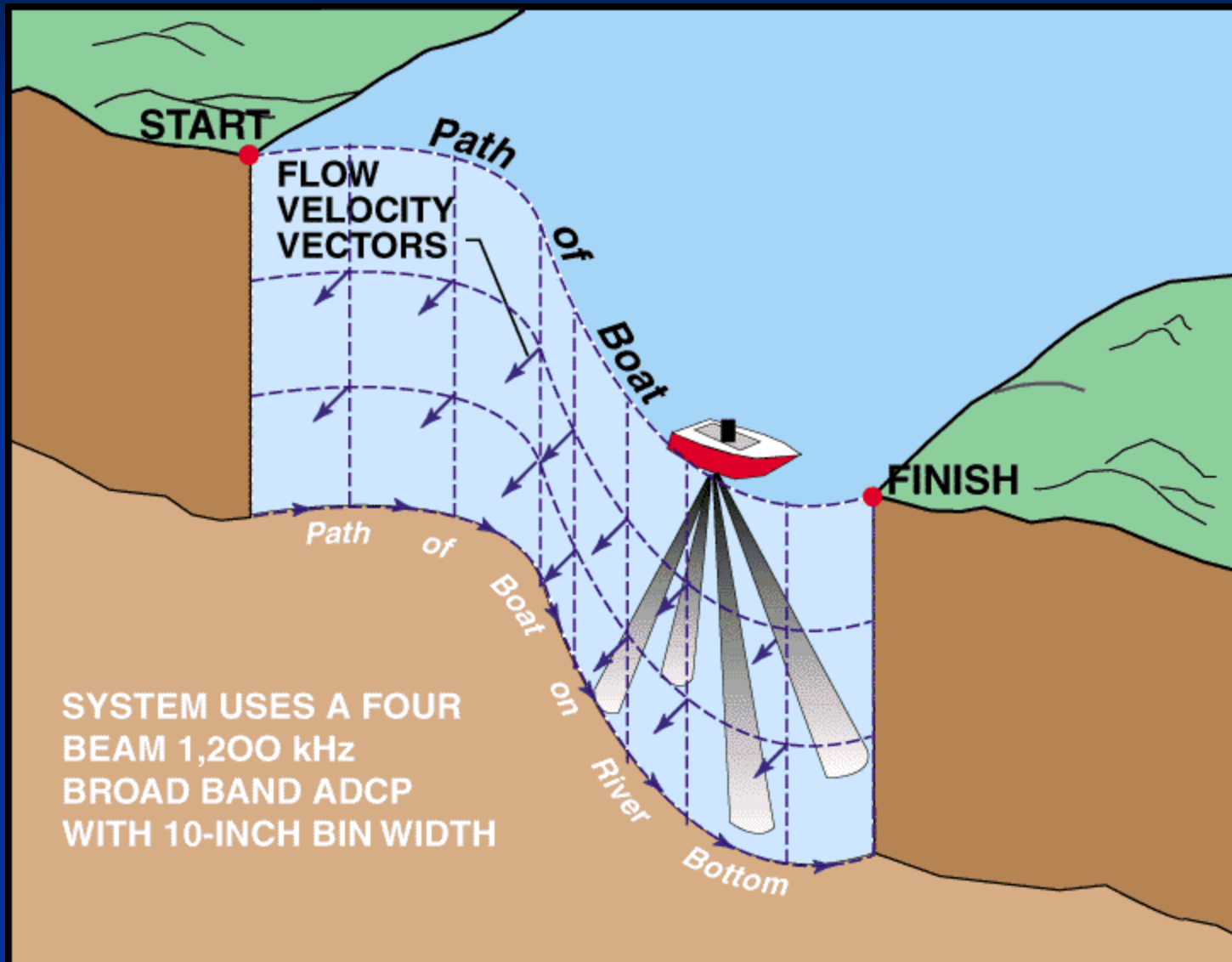
Calibration Procedures

- Detailed information available in USGS report

Ruhl, C.A., Simpson, M. R., 2005, Computation of discharge using the index-velocity Method in tidally affected areas: U.S. Geological Survey, SIR 2005-5004.

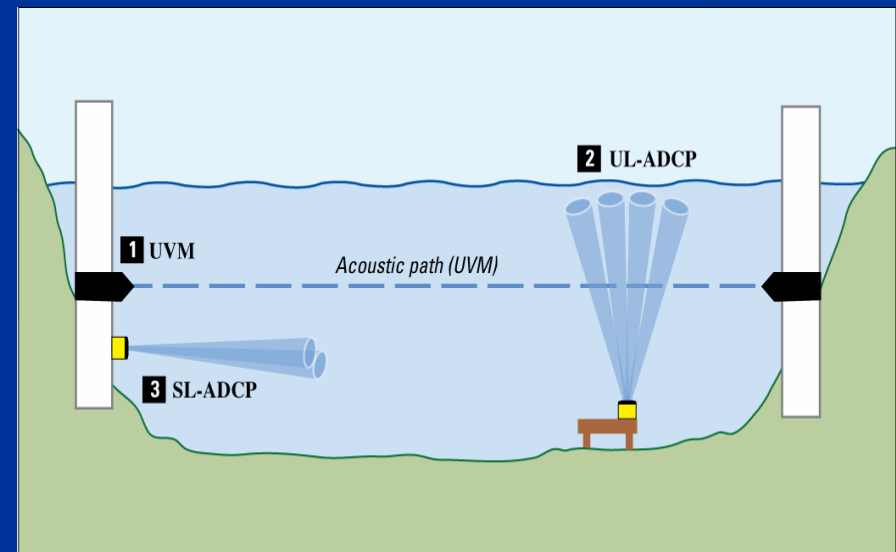
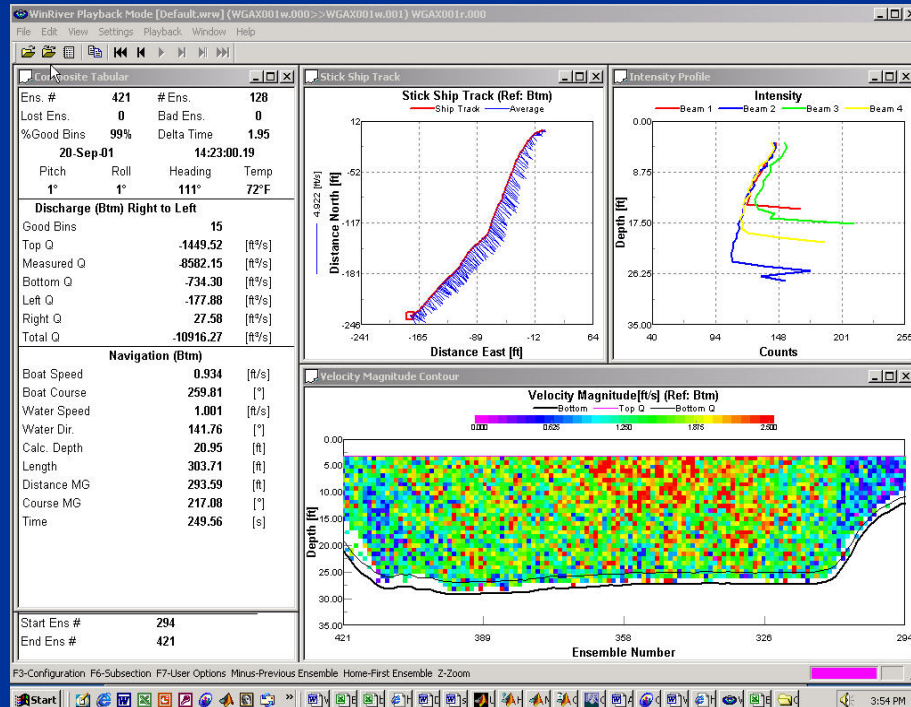
<http://pubs.usgs.gov/sir/2005/5004/>

Calibration Procedures



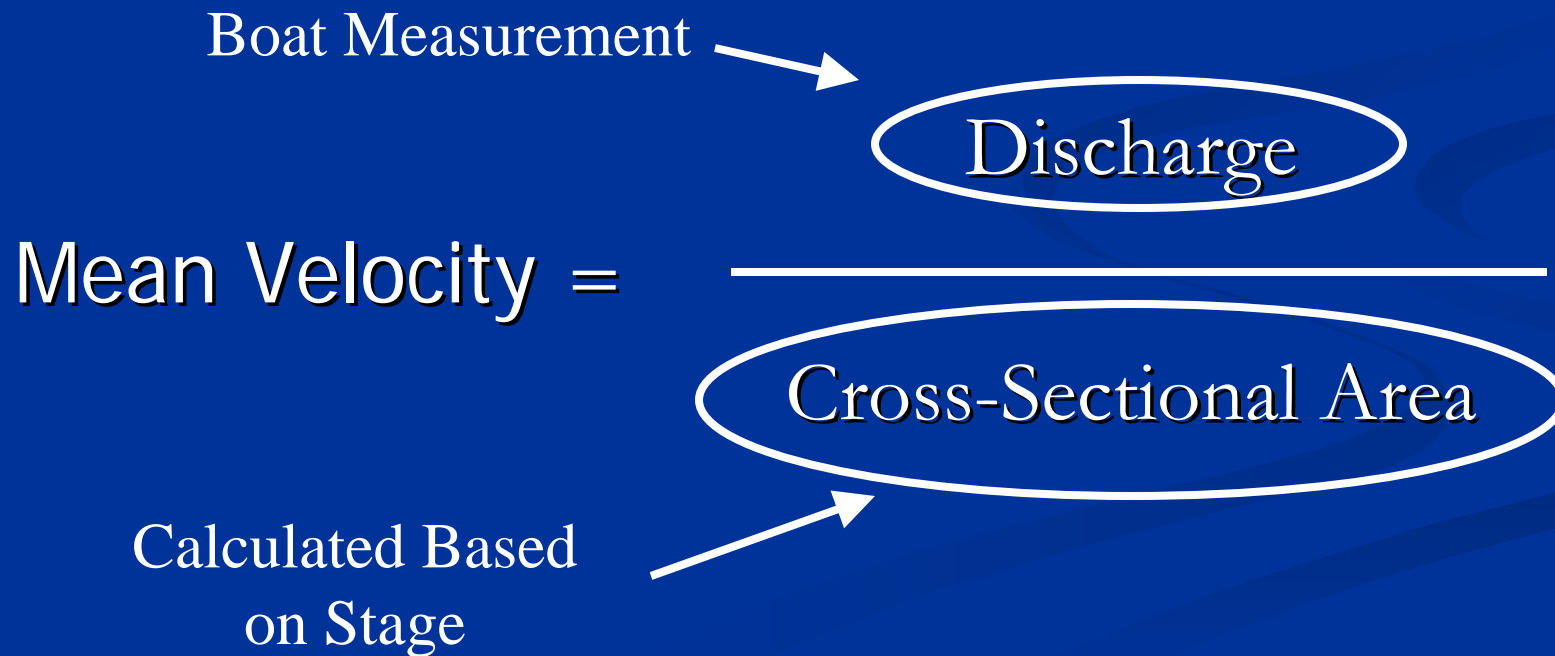
Calibration

■ Relating Boat and Index Measurements



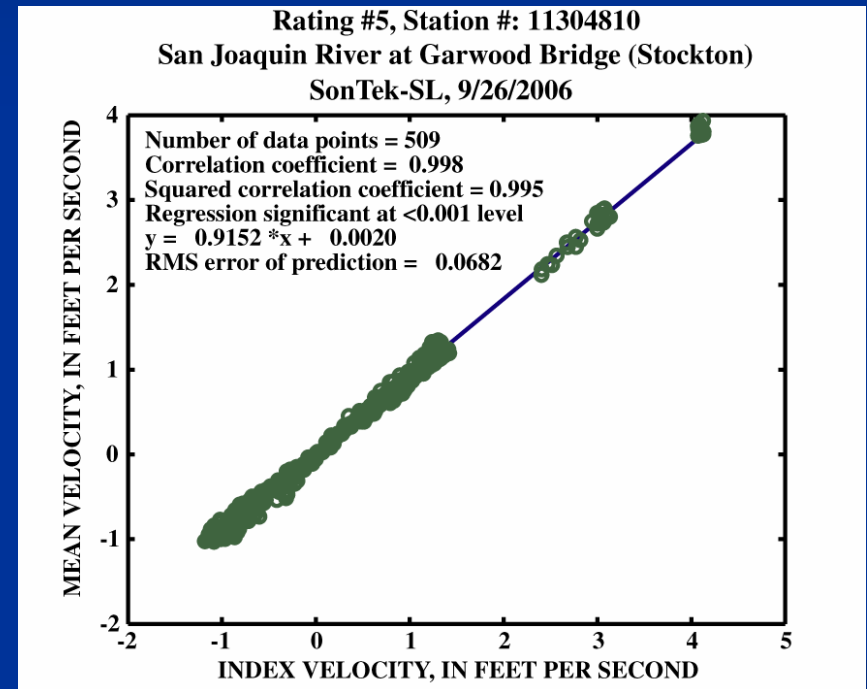
Calibration

■ Mean Cross-Sectional Velocity vs. Index Velocity



Calibration

- Strong Calibrations
 - Lots of data
 - Broad range of conditions
 - Good correlations



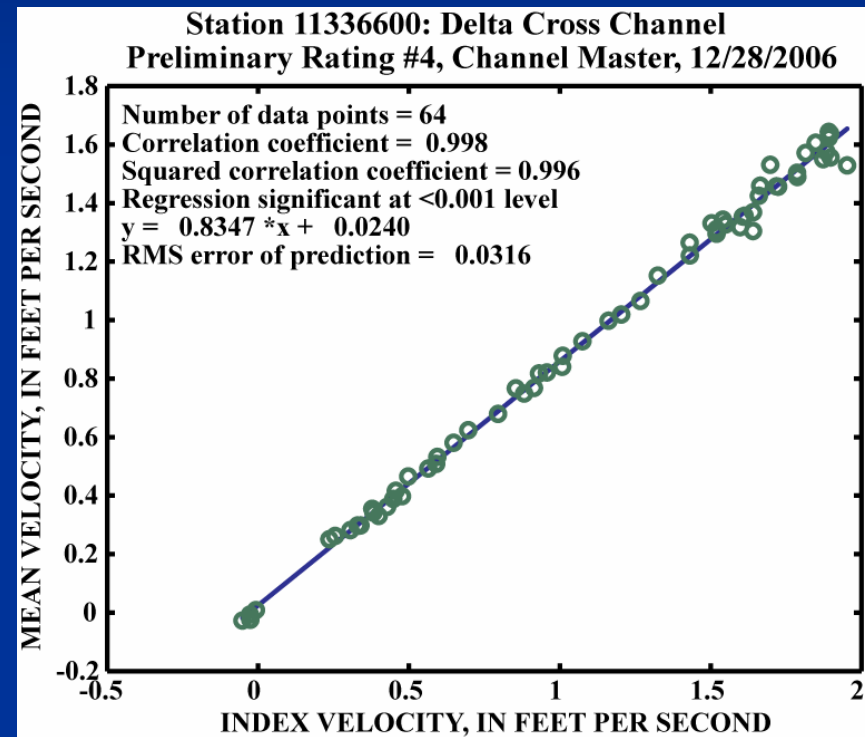
Calibration

■ Strong Calibrations

- Lots of data
- Broad range of conditions
- Good correlations

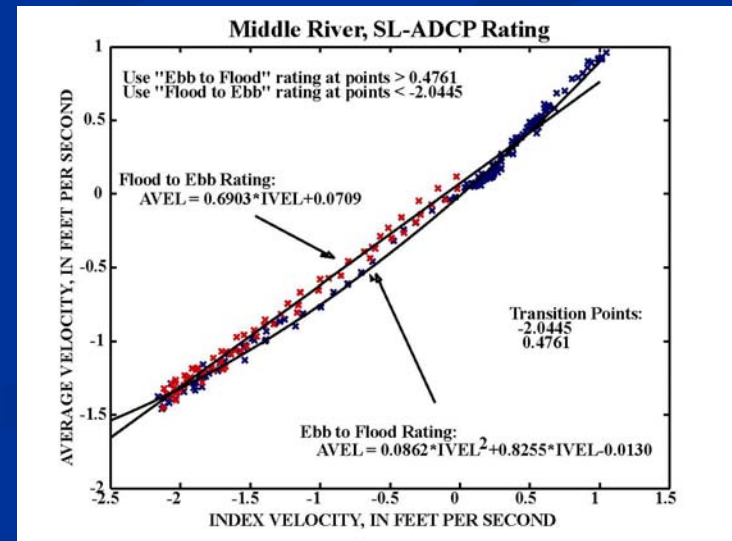
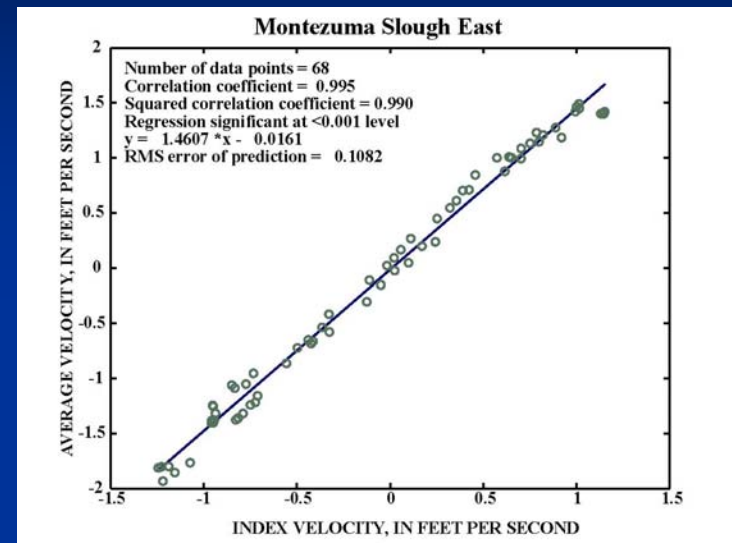
■ Good Calibrations

- Trade-offs between quantity and range of data
- Good correlations



Calibration

- Strong Calibrations
 - Lots of data
 - Broad range of conditions
 - Good correlations
- Good Calibrations
 - Trade-offs between quantity and range of data
 - Good correlations
- Fair Calibrations
 - Limited data
 - Limited range of conditions
 - Fair correlation



Calibration Assessment

- Strong calibration at most long-term monitoring stations
- EXCEPTIONS:
 - Reverse flows at Steamboat Slough
 - Very low flows at Delta Cross Channel (prior to Spring 2006)
 - High flows (Jan 2006) at Rio Vista ($>320,000$ cfs)
 - Grantline Canal / Old River at DMC with barriers in place

Calibration Assessments

- EXCEPTIONS (Continued):
 - New stations in Central Delta
 - Holland Cut & Old River at Franks Tract
 - All stations need more measurements
 - Stations with flood-ebb asymmetry
 - San Joaquin River at Jersey Point: 5/11/1994 – 9/30/2003
 - Middle River at Middle River: 6/6/2001 – 12/31/2001
 - Cache Slough: 2/19/2003 – 2/28/2005

Data Availability

Data Availability

■ Real-Time Data

■ USGS – NWIS Web

- Unit Values – last 31 days only
- Daily Values – updated daily

<http://waterdata.usgs.gov/ca/nwis>

■ CDEC

<http://cdec.water.ca.gov>

■ Special Studies Records

■ USGS – Jon Burau or Cathy Ruhl

- jrburau@usgs.gov
- caruhl@usgs.gov

■ Historical Long-Term Monitoring Record

■ USGS – NWIS Web

- Daily Values – updated daily

<http://waterdata.usgs.gov/ca/nwis>

■ USGS – Information Officer (Tom Haltom)

- (916) 278-3100,
tchaltom@usgs.gov

■ USGS – Unit Values Warehouse

- National effort – expected in December 2007

■ BDAT

<http://bdat.ca.gov/>

DSM2 Recalibration

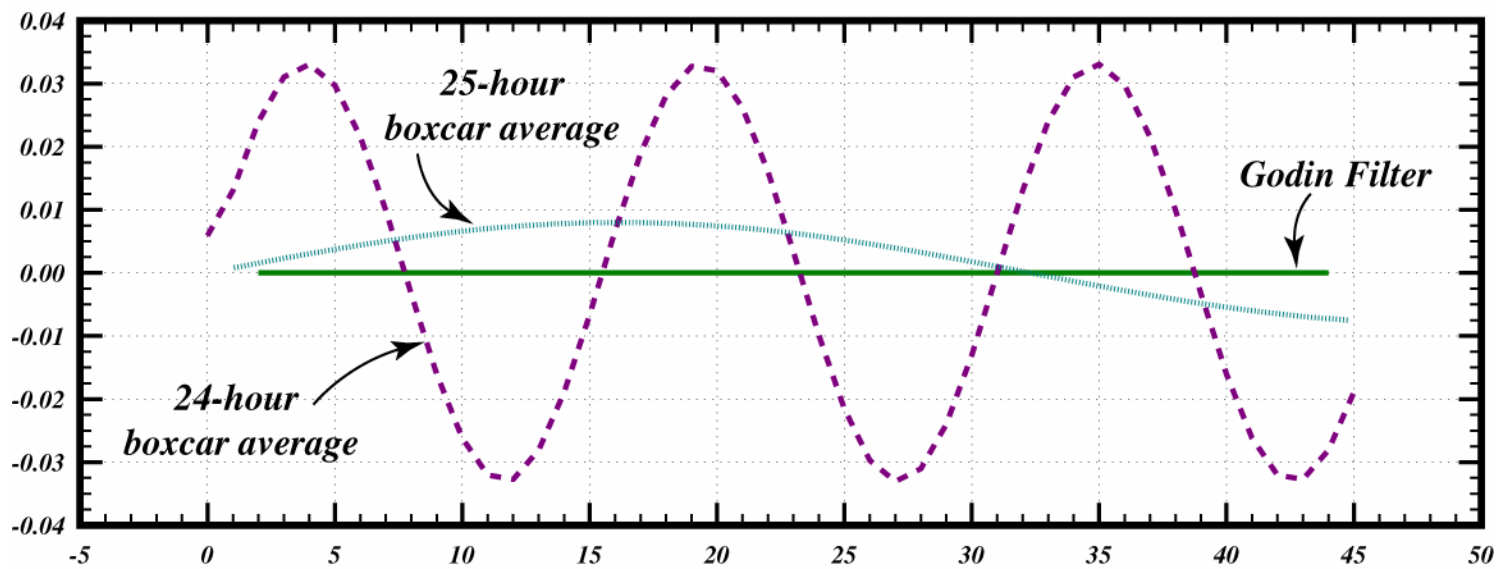
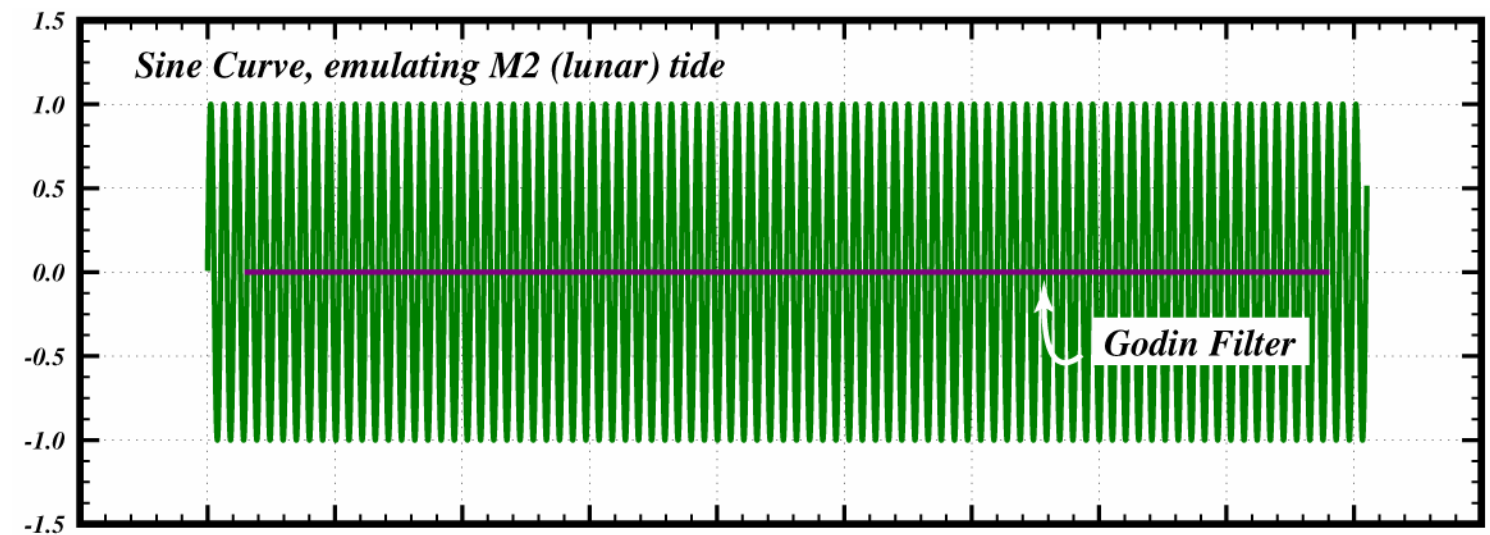
- Metrics for identifying optimal periods
 - Hydrology
 - Density of Data
 - Continuity of Data
 - Confidence in Data

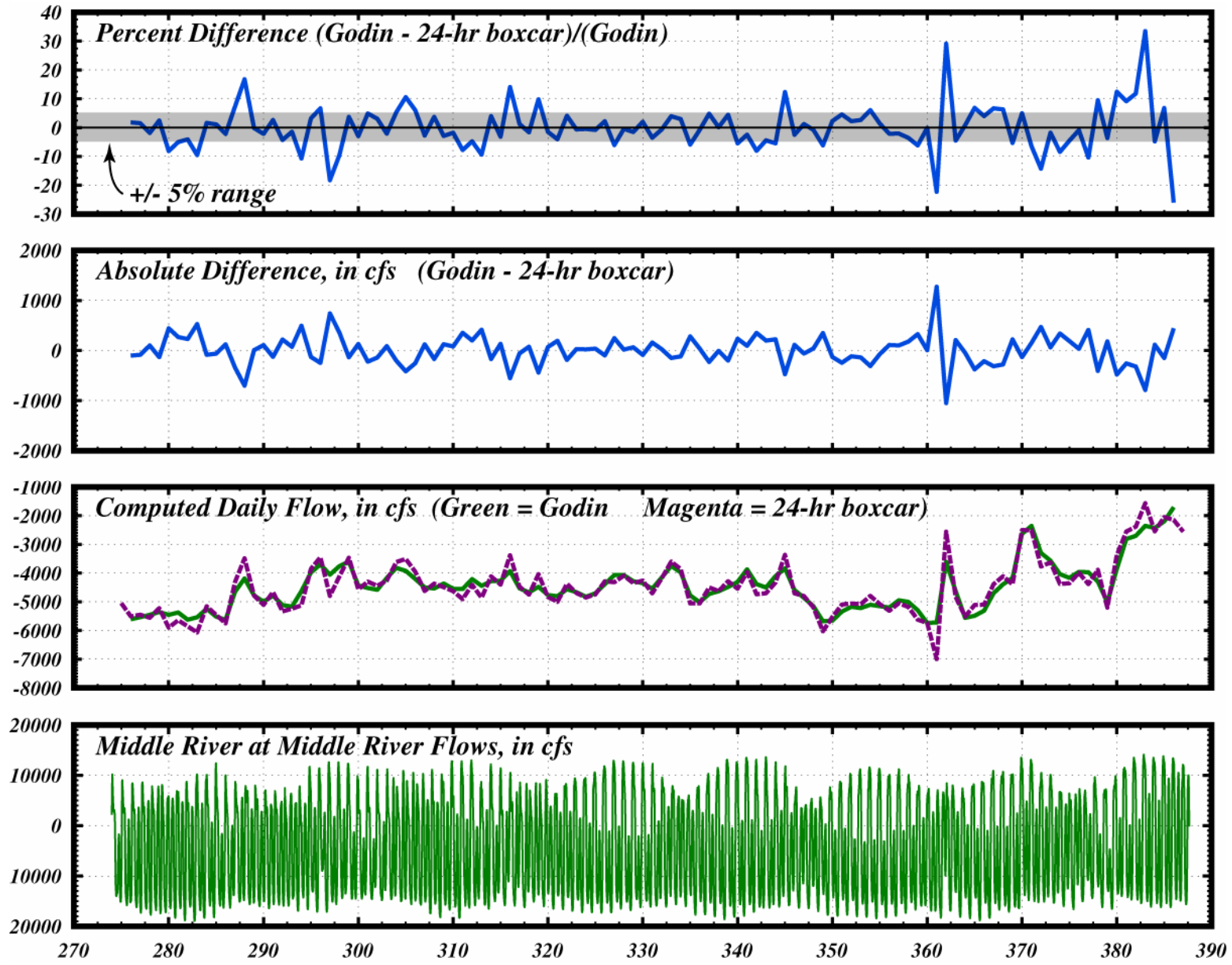
Langinappe

Tidal Filters: Godin vs. 24-hour boxcar

Tidal Filters

- Removes tidal variations
- Used for daily flow computation
- Godin filter is automatically applied in NWIS
- Loss of 35 hours at beginning and end of series
 - Periods of missing data are broadened when filter is applied



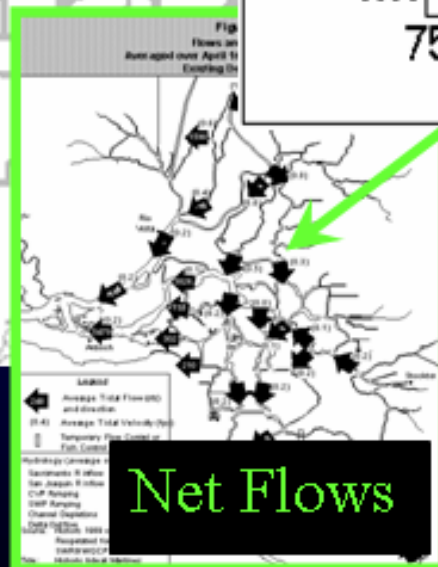
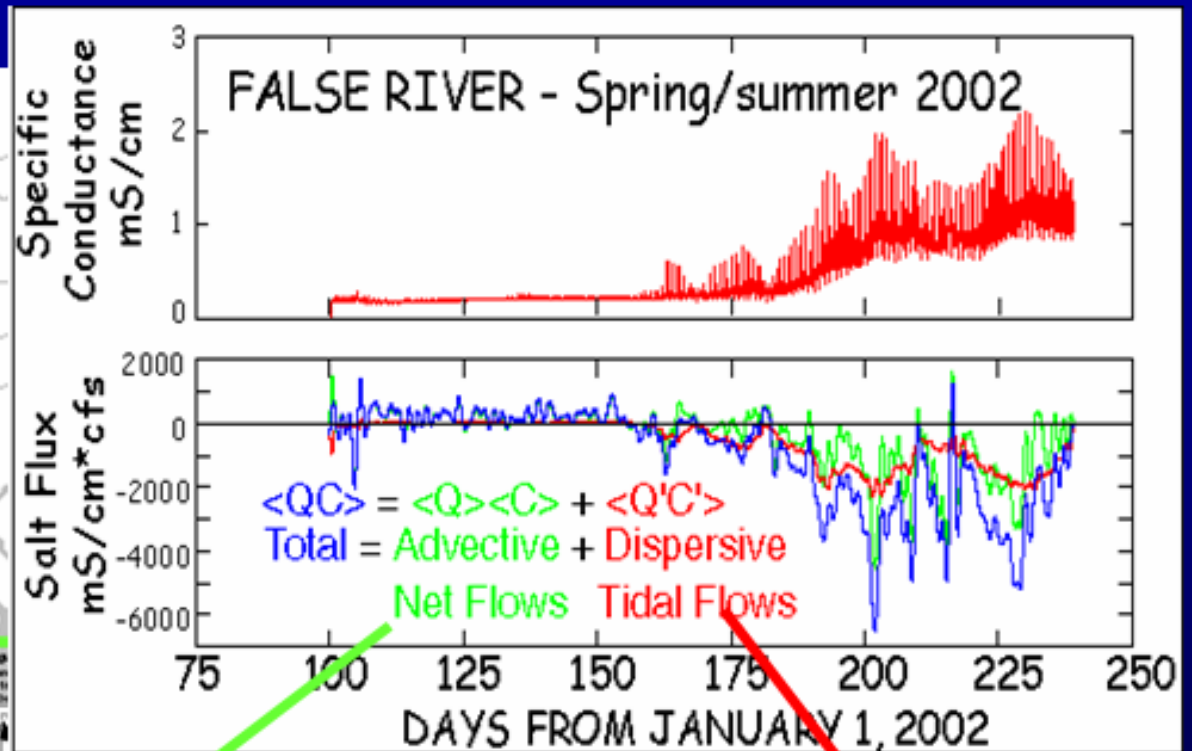


Many Thanks!

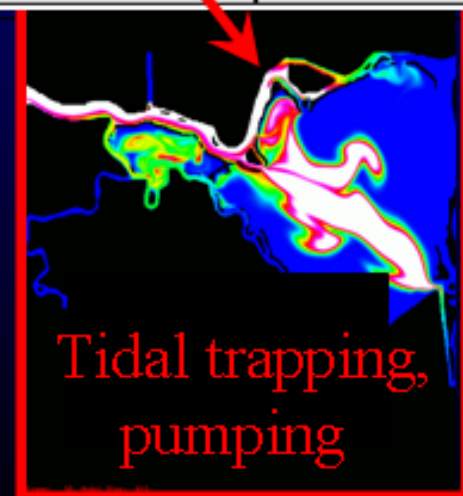


Modes of Transport - Salt Flux Decomposition

Site location



Net Flows



Tidal trapping, pumping

Building a network

- Identify the foundation
- Add parameters
 - Temperature
 - Conductivity
- Develop Tools
 - Load calculations
 - Salt Flux
 - Slack Water Plots
 - Spatial Distribution Maps
 - Tidal Excursion
 - Sampling in concert with the tides...tidal aliasing